Unnamed Tributary, Chickahominy River: Benthic TMDL Development

Technical Advisory Committee Meeting
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Project Team

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Chickahominy River, Unnamed Tributary

2004 Commitment

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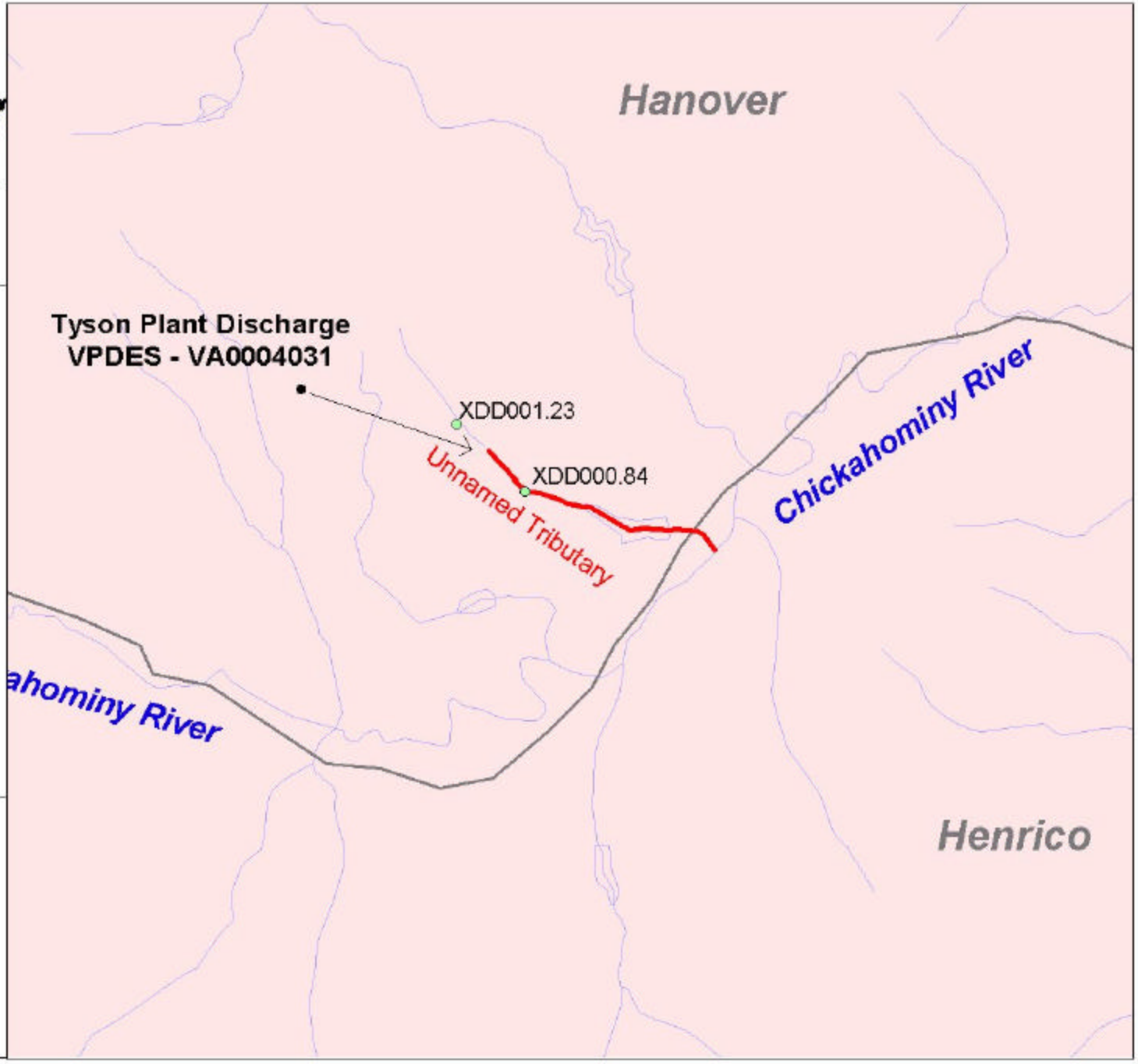

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Legend:

- Monitoring Stations
- 2002 303(d) Impaired Segments
- Counties/Cities
- Rivers & Streams (NHD)
- James River Basin

Biomonitoring & Assessment

- General Standard (9 VAC 25-260-20): *"All state waters shall be free from substances…which are harmful to human, animal, plant, or aquatic life."*
- EPA Rapid Bioassessment Protocol (RBP)
- Measurements of the benthic community. These "metrics" are used to determine the condition of the benthic community.
- Target Station vs. Reference Station (metric comparisons)
- Virginia Assessment Guidance: RBP score of moderately or severely impaired.

Benthic TMDL Development

Problem: Impaired streams do not support a healthy benthic macroinvertebrate community.

Questions:

- What factors are causing the problem?
- For each stressor, what level of improvement is needed? Virginia Water Quality Standards do not contain numeric criteria for sedimentation, nutrients, and other stressors.

Technical Approach: Non-impaired reference streams/ watersheds will be used to identify stressors and the level of improvement needed for each stressor (i.e. TMDL endpoints)

Reference Watershed Selection

- Goal: Identify similar, unimpaired watersheds that can be used to develop TMDL endpoints.

- Consider using the upstream segment of the unnamed tributary (above Station XDD001.23).

- Data used:

Biomonitoring Data	Ecoregion coverages
Topography	Land use distribution
Soils	Watershed size
Water quality data	Point source inventory

Reference Watershed Notes

- Summary: Non-impaired reference streams/watersheds will be used to identify stressors and to determine acceptable pollutant limits. Consider using the upstream segment for these purposes.

- This approach is needed because standards do not exist for the some potential stressors (i.e. sedimentation, nutrients, etc.)

- Pollutant limits (TMDL endpoints) will be based on the information gained from the reference watershed.

Stressor Identification Analyses

- Candidate Causes:
  - Sedimentation
  - Degraded water quality (e.g., low DO, ammonia)
  - Metals (copper)
  - Habitat impacts (riparian zone)

- Identified stressors need to be reduced to allow for improvement in the benthic community

- Data Analyses
  - Ambient Water Quality Data: Temperature, DO, BOD, sedimentation (TSS), nutrients, etc.
  - RBP habitat data (e.g. embededness)
  - 24-hour dissolved oxygen data
  - Metals and pesticides (sediment and water column data)
  - EPA toxicity tests: Measured survival/growth/reproduction of test organisms

Evaluating Candidate Causes

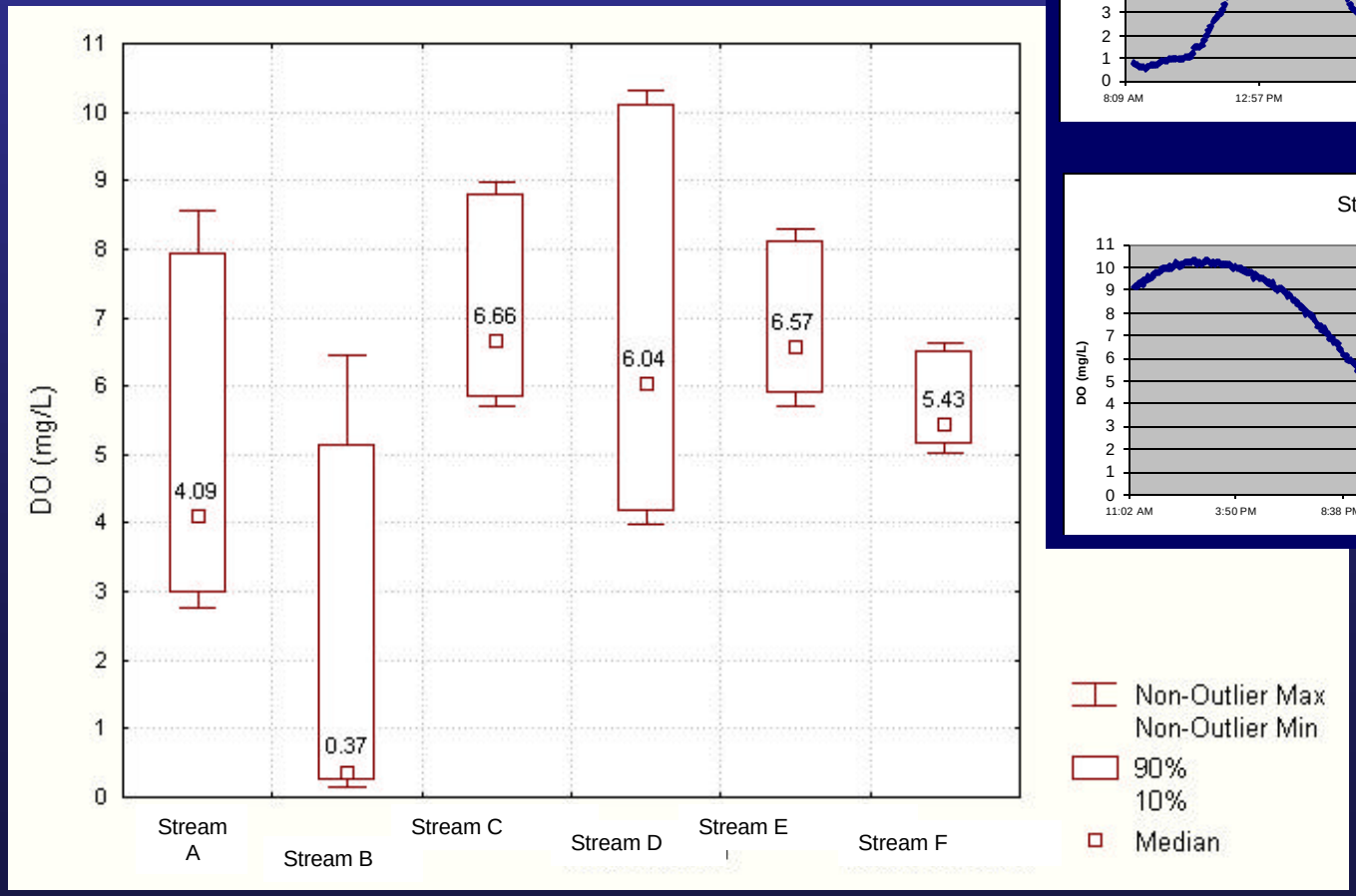
- Biomonitoring, water quality, toxic monitoring, and other available data can be used to evaluate candidate causes.

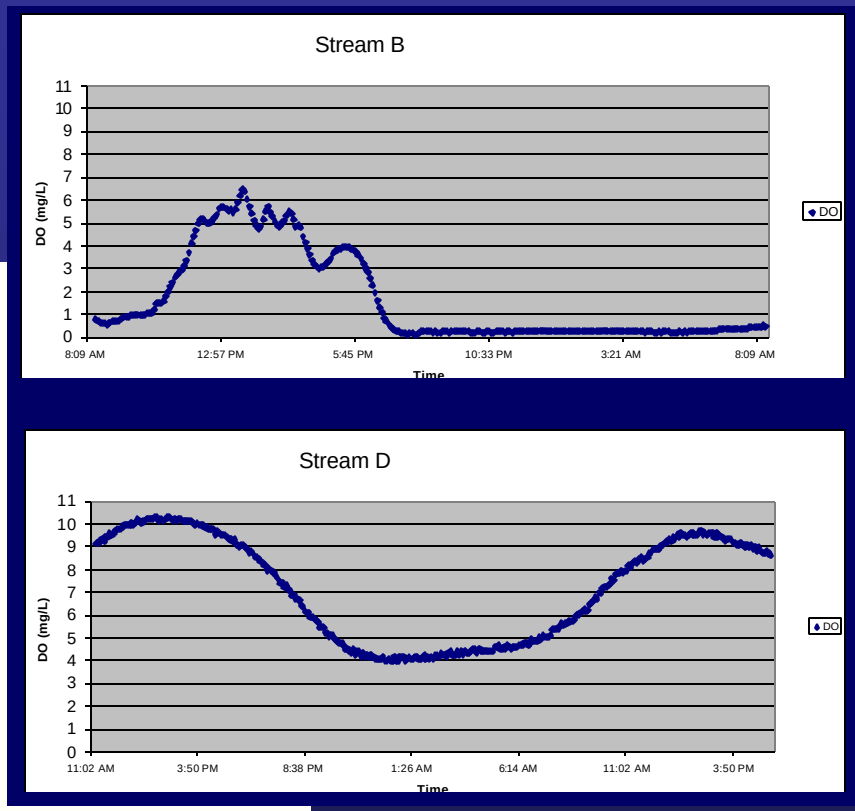
- Reference data define the natural or minimally-impaired condition.

- Exploring the data:
  - Plot target vs. reference data
  - Use statistics to examine cause-effect relationships
  - Review existing literature on stressors and known biological responses.
  - Compare biomonitoring metrics with reference streams. Examine the presence/absence of key taxa groups, functional feeding groups, etc.
  - "Weight of evidence" approach

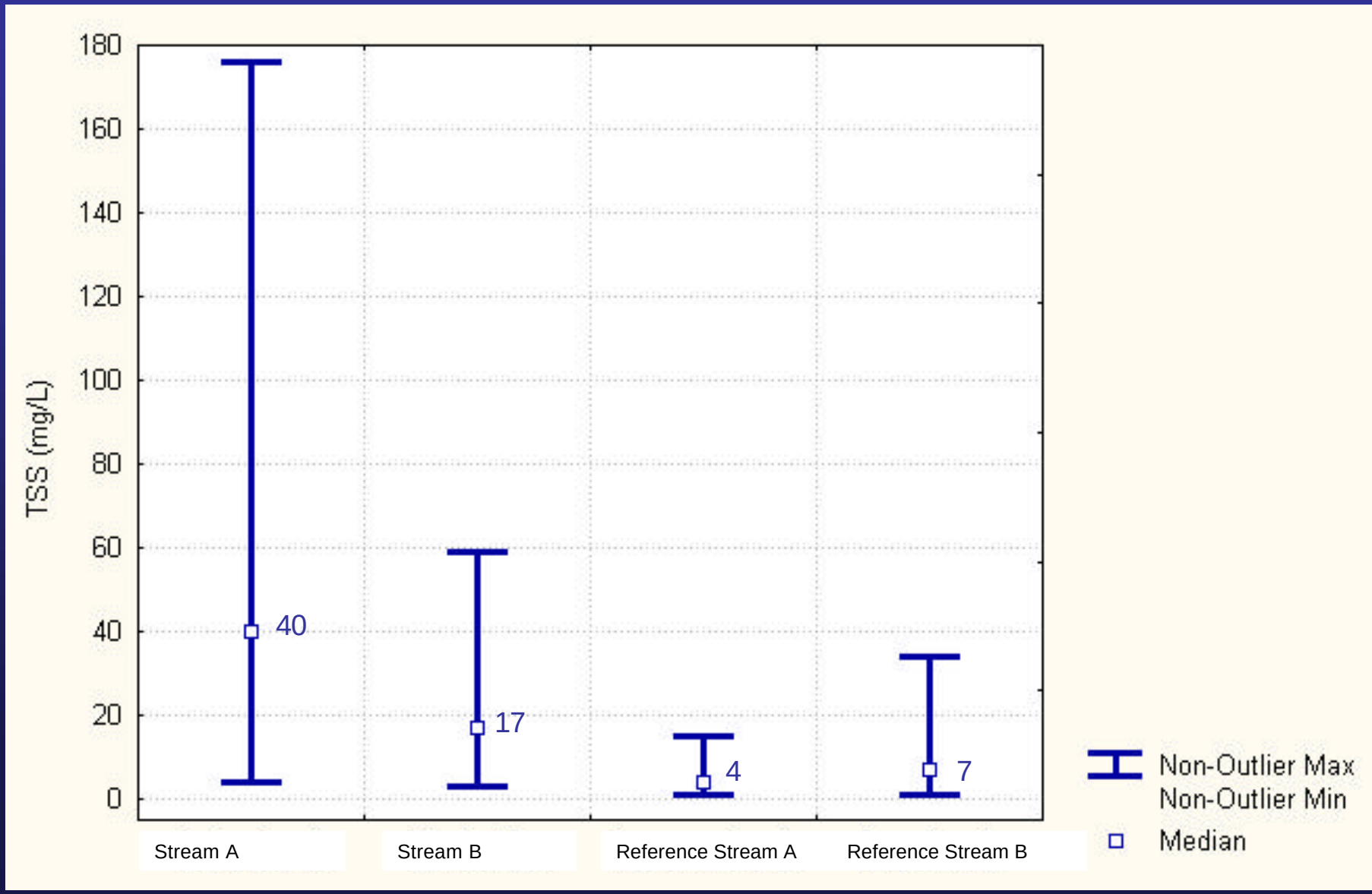
Example Dissolved Oxygen Analysis

Diel dissolved oxygen statistics – first 24-hour period





Example TSS Analysis (sedimentation measure)



Watershed Modeling

- Purpose: To simulate target and reference watersheds in order to determine pollutant loadings and the necessary pollutant reductions.
- Modeling approach selected will depend on the stressors (pollutants) identified.
  - GWLF (Generalized Watershed Loading Functions) model may be used to estimate sediment and phosphorus loadings. Phosphorus reductions would be necessary if low DO conditions are caused by excessive nutrient input.
  - Other pollutants : consider other approaches
- GWLF Model attributes
  - Continuous simulation model
  - Models surface runoff using the Soil Conservation Service curve numbers
  - Based on the Universal Soil Loss Equation (USLE)
- Margin of safety: 10% of load reserved

Source Assessment

- Sediment
  - Soil erosion (pervious lands, esp. agricultural land and construction areas)
  - Urban runoff (build-up and washoff of soil particles, debris, etc.)
  - Streambank erosion
  - Point source discharges
- Phosphorus
  - Soil erosion (phosphorus adsorbs to sediment particles)
  - Runoff from urban and agricultural lands
  - Animal waste
  - Septic systems

Sediment TMDL Example (% contribution by source)

Existing

Source Category	Stream A
Row Crops	60
Pasture/Hay	20
Transitional / Barren	2
Forest	2
Water	0
Urban	10
Groundwater	0
Point Sources	6
Septic Systems	0
Existing Load (lbs/year)	11,345,488

Allocation Loads

Source Category	Stream A (% reduction)
Row Crops	45%
Pasture/Hay	45
Transitional / Barren	70
Forest	0
Water	0
Urban	37
Groundwater	0
Point Sources	0
Septic Systems	0
Overall % Reduction	45%
TMDL Load – minus MOS (lbs/year)	6,270,928

Next Steps

- Begin collecting and compiling water quality monitoring data and discharge records
- Begin analyses of water quality and discharge monitoring data
- Propose modeling approach to address point and nonpoint sources
- Schedule 1st public meeting